UNITED STATES PATENT APPLICATION

# LUMINAIRE

## FIELD OF THE INVENTION

This invention relates generally to luminaires and more particularly to luminaires using reflectors to provide widespread lighting footprint.

## BACKGROUND OF THE INVENTION

A commonly used type of luminaire for illuminating large work areas is a reflective, fluorescent luminaire. These luminaires are typically either recessed into the ceiling or are mounted on the ceiling within a housing that contains the reflector(s) and lamps. Common applications include lighting for offices, workspaces or large retail areas.

Existing fluorescent luminaires typically include a number of fluorescent lamps disposed within a housing and have reflectors placed above the lamps. Often louvers are placed below the luminaire to prevent scattering of the light and to focus the light onto the horizontal surface below. As the fluorescent tubes are usually long and narrow, these luminaires also tend to be long and narrow. The industry standard fluorescent luminaire has eighteen cells formed by the louvers and uses three thirty-two Watt lamps. Most of the assemblies and reflectors are symmetrical. A drawback associated with such symmetrical luminaires is that the reflector is not particularly efficient because of internal reflections, the resulting light distribution pattern has low vertical foot-candles and the light pattern emitted is not optimized for any particular application.

In many lighting applications, the design goal is to provide a widespread light distribution pattern throughout the entire 180 degree area beneath the luminaire along with the greatest efficiency possible. The widespread light pattern increases the footprint over which light is

projected and also results in increased vertical foot candles. As opposed to measuring just the light intensity on the horizontal area beneath the luminaire, vertical foot candles measures the amount of light intensity on a vertical surface below the luminaire. Increased vertical foot candles can be desirable for applications that require light to be spread over a vertical surface such as a display rack, rather than being focused down onto the top of a horizontal surface such as a desk. Also, the greater the efficiency of the luminaire the more light there is that is available for the widespread footprint, thereby resulting in increased light intensity throughout the footprint. Greater efficiency also permits the use of smaller wattage, energy saving lamps in the luminaire. To achieve these goals, some other luminaires have used asymmetrical reflectors and asymmetrical lamp placements, however, most of these are for applications in which the luminaires are used to direct light only onto a specific area. These approaches have been used in a variety of luminaires, including those by Krogsrud in U.S. Pat. No. 4,683,526, by Grierson in U.S. Pat. No. 5,727,870 and by Shemitz in U.S. Pub. No. US2002/0003699. In each of these examples the luminaire provides increased wide angle lighting and vertical foot candles in a particular region below the luminaire, however, such increases are made at the expense of the lighting directly below the luminaire.

Another approach is to use an adjustable reflector to permit lighting the desired area regardless of the specific application. This however, results in a less stable luminaire that requires adjustment and costs more to manufacture because of the added complexity of having moving parts. Further, the efficiency of such luminaires is greatly reduced either because they use materials that are flexible that are not the best possible reflectors or they use more solid reflector elements that are moved around but have spacing between the elements. An example of

the flexible approach is shown by Waldmann in U.S. Pat. No. 6,244,729. An example of the movable elements approach can be seen by Littman in U.S. Pat. No. 5,564,815 and 5,803,585.

Thus, there is a substantial need for a luminaire that can provide wide angle lighting and significant vertical foot candles without requiring adjustment during installation or based upon subsequent applications.

SUMMARY OF THE INVENTION

The present invention is a luminaire which overcomes wide angle lighting drawbacks associated with the currently existing luminaires. More specifically, the luminaire comprises a housing in which multiple lamps are each disposed within their own reflectors and the reflectors have at least a pair of asymmetric reflectors that are disposed symmetrically relative to each other. This permits the middle lamps and reflectors, if used, to provide a standard light distribution pattern, while the outer asymmetric pairs are used to provide a wider angle of illumination and increased vertical foot candles.

In the preferred embodiment, the luminaire has three lamps and reflectors, including one symmetrical reflector in the center and two asymmetrical reflectors on the sides. The center lamp and reflector provides a standard light distribution pattern that is focused on the horizontal space below the luminaire, while the two side lamps and reflectors are principally responsible for providing the increased wide angle illumination and vertical.

The preferred embodiment of the luminaire disclosed herein has resulted in an eighty-five percent efficiency rating which makes the luminaire eligible for many available energy rebate programs. Further, the luminaire provides fifty percent greater vertical foot candles than the industry standard for luminaires having eighteen cells and using three thirty-two Watt lamps.

It would also be possible to use arrangements in which no symmetrical reflectors were used, but only pairs of asymmetrical reflectors disposed symmetrically relative to each other, so two, three, four or more pairs of lamps and reflectors could provide wider luminaires if required for an application.

Likewise, it would also be possible to use an arrangement where multiple lamps and symmetrical reflectors were used in the middle of the luminaire with the asymmetrical reflectors and lamp pairs being used toward the outside of the luminaire foe similar mixed light distribution patters.

By virtue of the foregoing, there is thus provided a luminaire that provides increased vertical foot candles and a widespread light distribution pattern. Additionally, the design of the reflectors provides a high efficiency as the result of the minimized internal reflections, thereby providing greater illumination and permitting the use of lower wattage lamps, thereby reducing usage of electricity while preserving usable light output. Further, the luminaire permits use of a single luminaire type for varying applications without requiring reflector adjustments.

These and other objects and advantages of the present invention shall become apparent from the accompanying drawings and the detailed description thereof.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description given below, serve to explain the principles of the invention.

FIG. 1 is a side perspective of the luminaire in accordance with the principles of the present invention.

FIG. 2 is a detailed side perspective of the symmetrical center reflector of the luminaire.

FIG. 3 is a detailed side perspective of the asymmetrical side reflectors of the luminaire.

FIG. 4 is a diagram showing the candela distribution for the preferred embodiment of the luminaire.

FIG. 5 is a bottom perspective view of a portion of the luminaire.

## DETAILED DESCRIPTION OF THE DRAWINGS

The luminaire 10, as depicted in FIG. 1, comprises a housing 12 in which three reflectors 14 are disposed, including a center reflector 15 and side reflectors 16. While it would be possible to form the reflectors together in a single piece, it is more convenient to form them as separate reflectors. The reflectors 14 are then joined using braces 18 with any common bonding means such as adhesives, screws or locking tabs. The edges 19a and 19b of the side reflectors 16 are then joined to the edge of the housing 12. Within each reflector 14 volume is a lamp 20 which is held in place at the ends via a set of commonly used fluorescent tube sockets 22. The sockets are electrically connected to a power source. Louvers 24, as depicted in FIG. 5, can also be attached to the luminaire 10 to provide additional direction for the light.

FIG. 1 also depicts the placement of the lamps 20 within the reflectors 14. In the preferred embodiment, each of the reflectors 14 is about 7.3 inches wide and 3.8 inches high. The center of each lamp 20 is placed about 1.2 inches below the top of the reflectors 14. The center of the lamp 20 in the center reflector 15 is centered about 3.65 inches from each outer edge of the center reflector 15 and the lamps 20 of the side reflectors 16 are biased toward the center of the luminaire 10, the center of such lamps 20 being about 3.1 inches from the inner edge of the side reflectors 16 and about 4.2 inches from the outer edges 19a and 19b of the side

reflectors 16. Accordingly, the lamps 20 of the side reflectors 16 are each located about 6.8 inches apart from the lamp 20 of the center reflector 15.

The upper portions of the reflectors are shown in more detail in FIGS. 2 and 3. The center reflector 15 is symmetrical and the two side reflectors 16 are asymmetrical. From the edge 30a to edge 30b the preferred reflector embodiment is about 3.75 inches wide. From the center point 31 of the center reflector 15, a V shaped peak 32 having an exterior angle of 110 degrees with the point disposed downward extends in each direction for .372 inches. The subsequent segments 33a – 33d are formed at interior angles 34a – 34d with the preceding segments, starting from the end of the peak 32, of 145 degrees, 154 degrees, 164 degrees and 167 degrees, and have respective lengths of .357 inches, .444 inches, .516 inches and .232 inches. The reflector 15 terminates from the end of segment 33d at an exterior angle of 125 degree with a length of .312 inches, thereby forming edges 30a and 30b. The asymmetrical reflectors 16 have a length measured from the outer edge of edge 40a to edge 40b of about 4.5 inches. The side reflectors also each start with a V shaped peak 42 having an exterior angle of 110 degrees formed with two segments of .372 inches. From the end of the exterior peak segment 42a, subsequent reflector segments 43a-43g are formed at interior angles 44a – 44g with the preceding segment, starting from the peak segment end 42a, of 145 degrees, 163 degrees, 174 degrees, 176 degrees, 176 degrees, 177 degrees and 176 degrees and having respective lengths of .58 inches, .379 inches, .379 inches, .379 inches, .379 inches, .379 inches and .191 inches. The reflector terminates from the end of segment 43g at an exterior angle of 147 degrees with a length of .312 inches, thereby forming the outer edges. The other symmetrical side of the reflector is formed with segments 45a – 45c at interior angles 46a – 46c to the preceding segments, starting from the interior end of the peak segment 42b, of 145 degrees, 128 degrees

and 154 degrees, and having respective lengths of .372 inches, .444 inches and .452 inches. The reflector terminates from the end of segment 45c at an exterior angle of 103 degrees with a length of .312 inches, thereby forming the inner edges.

The resulting luminaire 10 provides wide angle light distribution as shown in the candela distribution chart depicted in FIG. 5.

While the present invention has been illustrated by description of an embodiment which has been described in detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages will readily appear to those skilled in the art. Thus, the invention in its broadest aspects is not limited to the specific details, representative apparatus and method, and illustrative examples shown and described. Accordingly, departures may be made from the details without departing from the spirit or scope of applicant's general inventive concept.